UNIVERSITY OF TECHNOLOGY SYDNEY
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Efficient Solution Methods for Just-In-Time Machine and Shop Scheduling Problems

by

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A Thesis Submitted
in Partial Fulfillment of the
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Certificate of Authorship/Originality

I, Mohammad Mahdi Ahmadian, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Science at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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ABSTRACT

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The classical machine (i.e. single and parallel machine) and shop scheduling (i.e. flow-shop, job-shop and open-shop) problems are concerned with performing a set of independent jobs on a given set of machines with or without precedence relations. This thesis explores variants of such problems, pertinent to the practice of Just-In-Time (JIT) manufacturing, where each job (operation) has a due date (or due window) and any deviation from it would incur either earliness or tardiness costs. Embracing JIT philosophy by companies (by discouraging late delivery and reducing warehousing and inventory costs), and their dire need for developing more realistic scheduling models have led to a growing body of research on earliness-tardiness minimization since the late 1970s. Yet, most studies have been devoted to single machine scheduling problems, and very little research has been conducted to address the multiple-machine or shop scheduling settings. Moreover, the current solution methodologies often fail to deliver quality solutions for these problems particularly as the size of instances grows. Therefore, this PhD thesis will contribute to developing efficient algorithms that are capable of obtaining high quality solutions for computationally challenging instances. In addition, we contribute to the existing approaches by integrating exact and heuristic algorithms to maximize the benefits associated with them.

Dissertation directed by Dr. Amir Salehipour
School of Mathematical and Physical Sciences

Dedication

This thesis is dedicated to my mum Mehri Berangi who taught me to never give up.

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List of Publications

Journal Papers

J-1. **M. M. Ahmadian**, A. Salehipour and TCE. Cheng, "A meta-heuristic to solve the just-in-time job-shop scheduling problem," *European Journal of Operational Research*, 2020.

J-2. **M. M. Ahmadian** and A. Salehipour, "The just-in-time job-shop scheduling problem with distinct due-dates for operations," *Journal of Heuristics*, pp. 1-30, 2020.

J-3. **M. M. Ahmadian** and A. Salehipour, "Heuristics for flights arrival scheduling at airports." *International Transactions in Operational Research* 2020.

Conference Papers

C-1. **M. M. Ahmadian** and A. Salehipour, "A Matheuristic for Practical Flights Arrival and Departure Scheduling." *IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)*, pp. 1162-1166. IEEE, 2020.

Contents

List of Figures

Abbreviation

ACO - Ant Colony Optimization

B&B - Branch-and-Bound

CP - Constraint Programming

GA - Genetic Algorithm

JIT - Just-In-Time

LP - Linear Programming

MIP - Mixed Integer Programming

OM - Operations Management

PSO - Particle Swarm Optimization

R&S - Relax and Solve

SA - Simulated Annealing

TS - Tabu Search

VNS - Variable Neighborhood Search